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SOME RECENT SUN-SPOTS.*

BY C. D. PERRINE.

It has been thought that illustrations of a few of the more notable sun-spots of recent years might be of interest to the members of the Society. These illustrations are from negatives taken with the horizontal photoheliograph of the LICK Observatory. With one exception all of the groups shown have been enlarged $3\frac{1}{4}$ -diameters; and none have been retouched. The three views of the instrument show it entire and in detail. These views were taken at the time of the transit of *Venus* in 1882 (for which the photoheliograph was mounted) and hence show the surroundings somewhat different from their appearance to-day. The instrument is essentially the same, however, the only important change being the substitution of a vertical exposing shutter for the horizontal one shown in the illustration.

A short description of the instrument may not be out of place here. As will be seen from the illustrations, the objective is fixed on a brick pier, and the photographic plate is placed on a similar pier, forty feet to the south, and inside of the dark room. A hood extends from the objective to the dark room, for the purpose of overcoming as far as possible atmospheric waves, and a blackened tube extends about half-way toward the objective to prevent direct light from entering the room. The rays from the Sun are reflected to the objective by a plane glass mirror which is mounted to the north, on the lower extremity of a polar axis. The frame containing the mirror is pivoted at right angles to the polar axis, thus permitting of its adjustment to the Sun's varying declination. The polar axis is moved by clock-work which keeps the Sun's image fixed in a horizontal direction. In this way is obviated the necessity of the usual equatorial mounting for following celestial objects. The exposure is given by a shutter falling vertically in front of and near the plate. This shutter has a horizontal slit whose width can be varied to give the required exposure. In summer the proper width is found to be about $\frac{1}{16}$ inch with a corresponding exposure of 0".002, and in winter $\frac{1}{8}$ inch with an exposure of 0".004.

Negatives made with the photoheliograph are well adapted

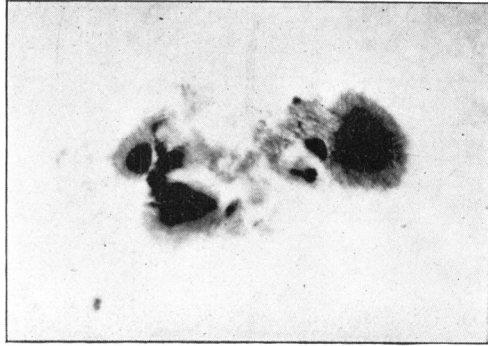
* The illustrations accompanying are from the *Photographic Times*.

for measurement to determine the positions of spots, but as the photographic plate remains fixed, the north pole of the Sun occupies different positions on the negative at different times of the day. In order to have a reliable reference line from which to measure, a plumb-line, with a very fine wire, is suspended in front of, and almost touching the sensitive plate, its image being impressed upon each plate. Then, by noting the time at which the photograph was taken, it becomes possible to locate the central meridian and the equator; all positions being referred to these two lines.

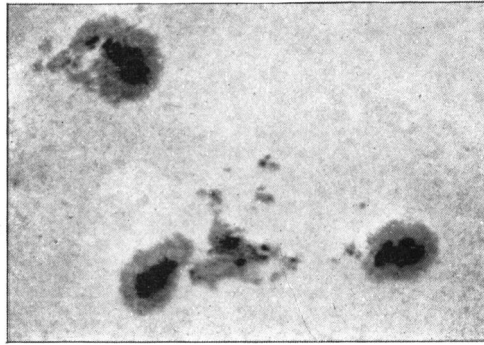
During the recent maximum there have been many interesting spots. A very notable group was the one of February, 1892, which is here reproduced without enlargement from the original negative by Professors SCHAEBERLE and CAMPBELL, the scale being about 191,000 miles to the inch. The large group of August, 1893, was hardly inferior in area and from its persistence was of unusual interest. It was a conspicuous object in July, again in its appearance the early part of August when it reached a maximum and still in September. It had dwindled to a small single spot the last of September, just before its disappearance. The view of this group on August 8th shows it at about its maximum. The view on August 31st shows the same group after the decline had set in, while September 27th is a view of it on its last apparition. The illustration of August 27, 1893, is of a single, nearly round spot just after its appearance on the eastern limb, and shows well the foreshortening due to its position. In August, 1894, a large, naked eye group was visible, and the illustration on August 22d shows it when near the western limb. The faculæ are very distinct. The changes in this group were unusually rapid and extended over large areas.

Among the many photographs secured are a number of spots of unusual interest, aside from size, but which require a more or less extended discussion to be of general interest.

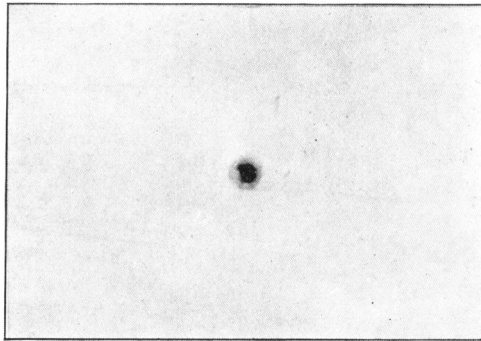
MOUNT HAMILTON, Cal., July 16, 1896.



August 8, 1893.

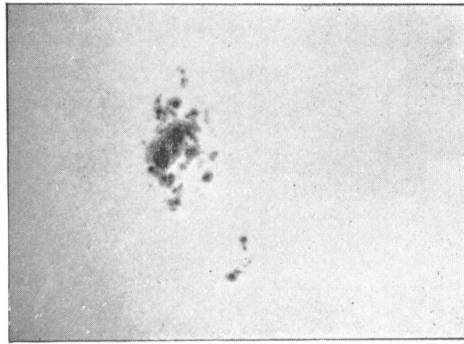


August 31, 1893.

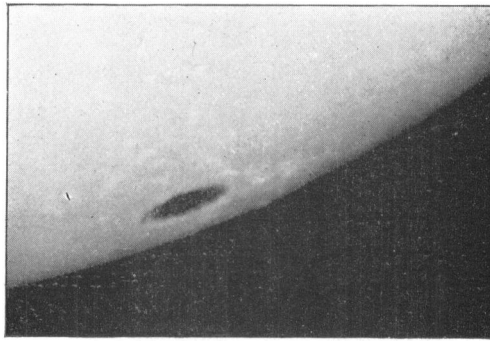


September 27, 1893.

SUN SPOTS. ENLARGED $\frac{3}{4}$ DIAMETERS.



February 11, 1802.

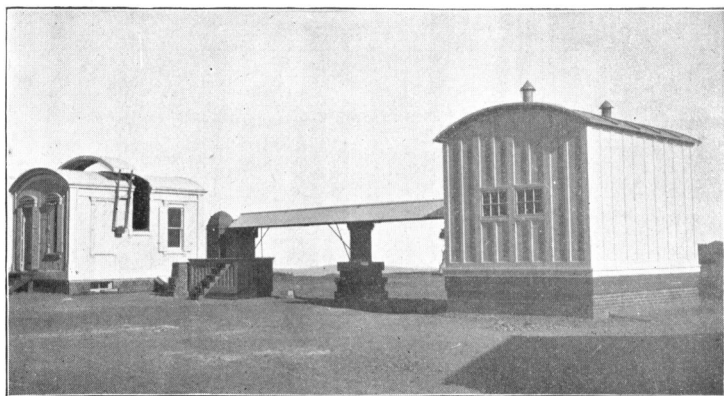


August 27, 1893.

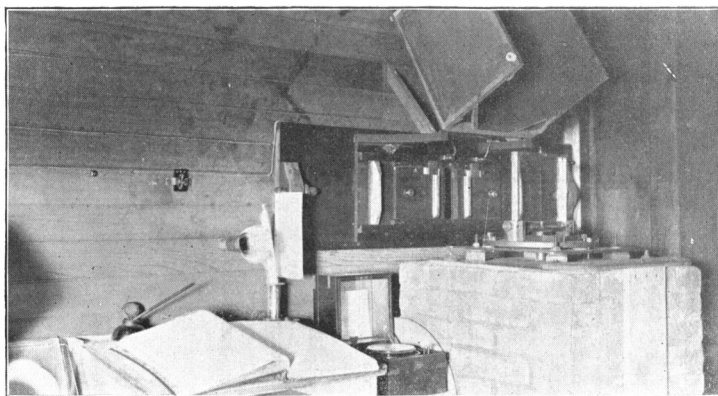


August 22, 1894.

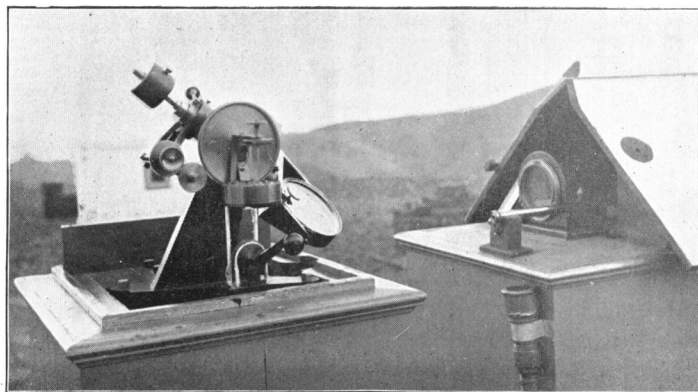
SUN SPOTS PHOTOGRAPHED AT LICK OBSERVATORY.



THE PHOTO-HELIOGRAPH.



INSIDE THE DARKROOM.



THE HELIOSTAT.